ACUTE TOXICITY SUMMARY

ACRYLIC ACID

CAS Registry Number: 79-10-7

I. Acute Toxicity Summary (for a 1-hour exposure)

Inhalation reference exposure level	**6,000 μg/m³**
Critical effect(s)	nasal irritation
Hazard Index target(s)	Respiratory System; Eyes

II. Physical and Chemical Properties (HSDB, 1994)

Description	colorless liquid
Molecular formula	$C_3H_4O_2$
Molecular weight	72.06
Density	1.0497 g/cm^3 @ 20°C (liquid)
Boiling point	141°C
Melting point	14°C
Vapor pressure	52 mm Hg @ 20°C
Flashpoint	54°C, open cup
Explosive limits	unknown
Solubility	soluble in benzene and acetone; miscible with water, alcohol and several ethers.
Odor threshold	0.06 ppm-1.0 ppm
Odor description	acrid, irritating
Metabolites	carbon dioxide and a short chain fatty acid (possibly 3-hydroxypropionic acid)
Conversion factor	1 ppm in air = 2.95 mg/m³

III. Major Uses and Sources

The most common industrial production process is the oxidation of acrolein, which is then further oxidized to acrylic acid. Acrylic acid is used in the manufacture of plastics, molding powder for signs, construction units, decorative emblems and insignias, emulsion in polymers, paint formulations, leather finishing and paint coatings.

IV. Acute Toxicity to Humans

Acrylic acid vapors have been reported to cause nasal and eye irritation in workers, although no concentrations were given in these reports (ACGIH 1986, 1991). Contact with the liquid may produce skin and eye burns and blindness.

Predisposing Conditions for Acrylic Acid Toxicity

Medical: Persons with severe uncorrected vision or chronic lung disease may be at increased risk for the adverse effects of acrylic acid (HSDB, 1994).

Chemical: Acrylic acid is a skin sensitizing agent as determined by the guinea pig maximization test, but not by the Draize test (ACGIH, 1991). This finding may indicate a sensitizing potential of acrylic acid in humans.

V. Acute Toxicity to Laboratory Animals

Inhalation exposure of rats to 2,000 ppm (6,000 mg/m³) acrylic acid for 4 hours resulted in no mortality (Carpenter *et al*., 1974). All animals (6) died at twice this concentration (4,000 ppm). An inhalation LC_{50} of 1,200 ppm (3,500 mg/m³) acrylic acid was determined for rats exposed for 4 hours (Majka *et al*., 1974).

In rats exposed to acrylic acid aerosol for 30 minutes, the LC50 is 8,612 ppm (25,400 mg/m³) and the LC_{01} is 1,203 ppm (3,550 mg/m³) (Hagan, 1988). For a 60-minute exposure the LC_{50} is 3,750 ppm (11,100 mg/m³) and the LC_{01} is 2,180 ppm (6,430 mg/m³); for a 2-hour exposure, the LC_{50} is 2,502 ppm (7,381 mg/m³) and the LC_{01} is 928 ppm (2,740 mg/m³). Treatment related signs of toxicity included eye squinting, lacrimation, rhinorrhea, salivation, gasping, difficulty in breathing and corneal opacities. In addition to these signs, following the 2-hour exposure, rales, loss of righting reflex, ataxia, lethargy and prostration were reported. Rats exposed to acrylic acid vapors ranging from 928 to 2,142 ppm (2,740 to 6,319 mg/m³) for 60 minutes showed signs similar to the animals exposed at the same concentrations of aerosol. However, unlike the aerosol, recovery was more rapid and no deaths occurred following exposure to vapors.

A single 5-hour exposure to 6,000 ppm (18,000 mg/m³) acrylic acid in rats produced nasal and eye irritation, respiratory difficulties, unresponsiveness and death in 1 of 4 animals (Gage, 1970). An autopsy revealed lung hemorrhage and degeneration of the liver and kidney tubules. Four 6-hour exposures to 1,500 ppm (4,400 mg/m³) in 8 animals produced nasal discharge, lethargy, weight loss and congested kidneys. Nasal irritation, lethargy and reduced weight gain were observed after twenty 6-hour exposures at 300 ppm (900 mg/m³). Histopathological examination showed no damage to tissues. No toxic signs were observed in 8 rats exposed 20 times to 80 ppm (240 mg/m³) for 6 hours.

Histologic examinations were performed in ten rats and ten mice exposed to acrylic acid vapor 6 hours per day, 5 days per week for 2 weeks at 25, 75, and 225 ppm (74, 220, and 664 mg/m³) (Miller *et al*., 1981). At 25 ppm, very slight olfactory tissue effects (unspecified) were observed in mice. Slight focal degeneration of the olfactory tissue without metaplasia was found in mice at 75 ppm. No adverse effects were noted in rats at this dose. Labored breathing and apparent nasal irritation during exposure occurred in mice exposed to 225 ppm. Slight focal squamous metaplasia of the olfactory epithelium was observed in both rats and mice at this concentration. The investigators noted that since rodents are obligate nasal breathers, irritation of the nasal mucosa was likely to be pronounced in these animals. Majka *et al*. (1974) observed that exposure of rats to 240 ppm (710 mg/m³) acrylic acid, 4 hours per day for 5 weeks resulted in reduced body

weight gain, increased reticulocyte count, and irritation with irreversible changes to the skin and eyes.

The instillation of 0.5 ml of a 1% solution of acrylic acid caused severe irritation and corneal burns in the eyes of rabbits (Union Carbide Corp., 1977).

VI. Reproductive or Developmental Effects

Four groups of 5 female rats were injected intraperitoneally with 2.5, 4.7, or 8 mg/kg body weight acrylic acid three times on days 5, 10, and 15 of gestation (Singh *et al*., 1972). Skin abnormalities (hemangiomas) were observed in the offspring of animals from the two highest dose groups. Skeletal abnormalities and embryotoxicity were observed in the litter from the highest dose group.

DePass *et al*. (1983) conducted a one-generation reproduction study in rats. Animals were exposed to doses ranging from 83 to 750 mg/kg/day acrylic acid in the drinking water throughout gestation and lactation. No statistically significant changes in reproductive indices were observed.

Pregnant rats were exposed via inhalation to concentrations of acrylic acid ranging from 40 to 360 ppm (120-1,060 mg/m³) on days 6 through 15 of gestation (Klimisch *et al*., 1983). Decreased body weight and feed consumption were observed in the dams exposed to 120 or 360 ppm acrylic acid. No embryotoxic or teratogenic effects were observed.

VII. Derivation of Acute Reference Exposure Level and Other Severity Levels (for a 1-hour exposure)

Reference Exposure Level (protective against mild adverse effects):
2 ppm (6,000 μg/m³)

Study	Gage, 1970
Study population	groups of 4-8 rats
Exposure method	inhalation
Critical effects	nasal irritation
LOAEL	300 ppm
NOAEL	80 ppm
Exposure duration	6 hours/day (on 20 occasions)
Extrapolation to 1 hour	$C^n * T = K$, where n = 2 (ten Berge *et al*., 1986)
Extrapolated 1 hour concentration	200 ppm (80^2ppm * 6 h = C^2 * 1 h)
LOAEL uncertainty factor	1
Interspecies uncertainty factor	10
Intraspecies uncertainty factor	10
Cumulative uncertainty factor	100
Reference Exposure Level	2 ppm (6 mg/m³; 6,000 μg/m³)

Level Protective Against Severe Adverse Effects

No recommendation is made due to the limitations of the database.

Slight focal degeneration of the olfactory tissue was observed in mice exposed to 75 ppm (225 mg/m³) acrylic acid, 6 hours per day for 10 days (Miller *et al*., 1981). An ERPG-2 of 50 ppm (150 mg/m³) was recommended based on this study (AIHA, 1991). The AIHA document stated that strong odors and slight eye irritation may be present at this level but that escape would not be impaired. The document incorrectly states that no effects were seen at 75 ppm. Because no safety factors were used in the derivation of this value, it should be reevaluated. Therefore, no recommendation can be made.

Level Protective Against Life-threatening Effects

No recommendation is made due to the limitations of the database.

NIOSH does not list an IDLH for acrylic acid. An acute inhalation study in rats determined a 1-hour LC_{01} of 2,180 ppm (6,430 mg/m³) acrylic acid aerosol (Hagan, 1988). In addition, no deaths were observed in rats exposed for 6 hours per day for 4 days to 1,500 ppm (4,400 mg/m³) acrylic acid (Gage, 1970). AIHA (1991) derived an ERPG-3 value of 763 ppm (2,250 mg/m³). Because the ERPG-3 value was based on a personal communication (Hagan, 1988) with little supporting documentation, no recommendation can be made.

VIII. References

(ACGIH) American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Cincinnati (OH): ACGIH; 1991. p. 26-29.

(ACGIH) American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati (OH): ACGIH; 1986. p. 14.

(AIHA) American Industrial Hygiene Association. Emergency response planning guidelines. Akron (OH): AIHA; 1991.

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(HSDB) Hazardous Substances Data Bank. National Library of Medicine, Bethesda, Maryland (CD-ROM version). Denver (CO): Micromedex, Inc.; 1993. (Edition expires 11/31/93).

(IARC) International Agency for Research on Cancer. IARC monograph on the evaluation of the carcinogenic risk of chemicals to man: some monomers, plastics and synthetic elastomers, and acrolein. Vol. 19. Lyon: IARC; 1979. p. 47-71.

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U.S.EPA. Acrylic acid. Reference Concentration for chronic inhalation exposure (RfC). U.S.EPA Integrated Risk Information Service (IRIS); 1990.